

PSOROTHAMNUS FREMONTII AND *PSOROTHAMNUS ARBORESCENS*
(FABACEAE) IN CALIFORNIA

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ABSTRACT

This note addresses the identification and California distribution of *Psorothamnus fremontii* (A. Gray) Barneby s.l. and *P. arborescens* (A. Gray) Barneby s.l. Both plants are generically known as indigo bush. *Psorothamnus fremontii*, sometimes called Fremont's indigo bush, can only be distinguished from *P. arborescens* by analysis of the seed pods, which differ in size, arrangement and exudates of their glands. The distribution of *P. fremontii* is very limited in California, restricted to the Grapevine Mountains, in Death Valley National Park, near the Nevada border, and the Providence Mountains, California State Recreation Area and nearby Lavic. *Psorothamnus arborescens* is much more common in California and occurs throughout the Mojave Desert and barely into the Great Basin Desert, from near Mount San Jacinto to the White Mountains.

Key Words: *Psorothamnus fremontii*, *Psorothamnus arborescens*, California, identification, locations.

We became interested in locating *Psorothamnus fremontii* because it may have been used medicinally (Garcia and Adams 2005). After searching the desert, reading articles written about the plant, talking to botanists, searching herbaria, publications and on-line resources, we began to wonder if *Psorothamnus fremontii* actually occurs in California.

Psorothamnus arborescens (A. Gray) Barneby and *P. fremontii* (A. Gray) Barneby were initially collected by John Fremont on his second expedition into California (Smucker and Fremont 1856). On April 25, 1844, he recorded in his journal the discovery of a new psoralea, "handsome leguminous shrub, three or four feet high, with fine bright purple flowers." When he made the discovery he was probably in the Silurian Valley, California, about 25 mi southwest of Bitter Spring at 35°13'08"N, 116°23'28"W, as measured by Fremont. However, Fremont did not publish the plant description himself. Fremont sent his specimens to the botanist John Torrey, who wrote a description of the plant in latin. This description was sent to another botanist, Asa Gray who included it in an article he wrote (Gray 1855). In this article, Asa Gray reported that Fremont had collected *Dalea arborescens* somewhere east of the Sierra Nevada Mountains. A translation of Torrey's technical description is presented below.

"*Dalea arborescens* (Torr. ined.) many branches, with glands, subspinous, adult branches glabrous, young branches, leaves and calyxes tomentose, the leaves are opposite, uneven and obovate, the inflorescence is in short dense ears (like corn), sewn

together by small bracts, calyx with sharp teeth, the bell shaped flower tube is the same length as the calyx, the two (lobes) above are oblong-triangular, the other (lobes) are narrow lanceolate and purple."

A further description was provided by Asa Gray, who wrote that "*D. arborescens* is a small tree, with few glands. A few minute, tubercular glands are found on the branches after removing the woolly covering. The leaves are petioled. The flower calyxes are large."

Asa Gray wrote that *P. fremontii* was collected and described by Fremont during the month of May, 1844, somewhere west of the Colorado River (Gray 1855). In May, Fremont was in Nevada (Smucker and Fremont 1856). He marched across southern Nevada to the Virgin River gorge. Nowhere in Fremont's diary does he record the collection of *P. fremontii*. This was entirely left for Torrey to describe and Gray to report. The description from Torrey, published by Gray, was in latin and is translated below.

"*Dalea fremontii* (Torr. ined.) bushy, many branches, few punctate glands, silken hairs, petiole leaves (leaflets?), simple obovate-spatulate, trifoliate leaves in even multiples, leaves obovate, subspinescent twigs, inflorescence wide, sessile, open, crowded spikes, bracts often awl shaped and crowded, bell shaped tube, two (lobes) above are triangulate, the rest are awl shaped, corolla purple, obcordate flag and keel are thick."

Torrey did not describe the seed pods of either *P. arborescens* or *P. fremontii*. Asa Gray did not add anything about the seed pods. He did write ad-

ditional information about *P. fremontii*. "It has copious reddish purple flowers. The calyx is minutely silky pubescent. The young parts of the plant have many inconspicuous glands. The leaflets are shorter than the petioles." It is not clear how Gray separated the species *D. arborescens* and *D. fremontii*. His description hints at the presence of more glands on the young branches of *fremontii* than *arborescens*. This is an observation we disagree with.

Barneby wrote extensively about *Psorothamnus* and was responsible for placing *P. arborescens* and *P. fremontii* in *Psorothamnus* rather than *Dalea* (Barneby 1977). *Dalea* plants are usually unarmed, whereas *Psorothamnus* generally have thorns or at least sharply pointed twigs. The calyx tube in *Dalea* is 10-ribbed, whereas *Psorothamnus* simply has unequal calyx lobes. There are 10 stamens in *Psorothamnus*, but 5, 9 or 10 stamens in *Dalea*. Barneby wrote that the geographic distribution of the plants is usually the key to identifying the species or subspecies (Barneby 1977). He did, however, note that *P. arborescens* and *P. fremontii* are "... sharply characterized by the pods. The seed pods of *P. fremontii* were covered with orange glands that run together forming lines or ridges. The seed pods of *P. arborescens* had a few, large, blister like glands scattered in a polka dot pattern." The surface of the *P. fremontii* pods was described as caramelized. Barneby described four subspecies of *P. arborescens*, mostly based on geographic distribution as, *simplifolius*, *arborescens*, *pubescens* and *minutifolius*. *Psorothamnus fremontii*, he claimed, is found only in the far eastern Mohave Desert. He defined two subspecies, again largely based on geographic distribution, *fremontii* and *attenuatus*.

Isely (1998) also found that *P. arborescens* and *P. fremontii* could be distinguished based on the glands found on the seed pods. The pods of *P. arborescens* had large glands randomly distributed. *Psorothamnus fremontii* had numerous small glands that tended to merge forming ridges. Isely recognized four subspecies of *P. arborescens* and two subspecies of *P. fremontii* based almost entirely on geographic distribution, just as Barneby had done earlier. The Jepson manual section on *Psorothamnus* was written by Isely and requires seed pods to identify the species, *fremontii* and *arborescens* (Hickman 1993).

The senior author visited the herbaria at Rancho Santa Ana Botanical Gardens, Claremont, California (RSA), the University of California Berkeley (JEPS) and the California Academy of Sciences, San Francisco (CAS) to examine specimens of *P. fremontii* and *P. arborescens*. Many of the *P. fremontii* specimens lacked seed pods and appeared to have been identified based on geography. The senior author examined 20 specimens labeled *P. arborescens* and 10 specimens labeled *P. fremontii* in Claremont. None of the *P. fremontii* specimens contained seed pods. Positive identification of the specimens was therefore not possible. Most of the

specimens had been previously identified by others, apparently based on geographic distribution. Some of the *P. arborescens* specimens had seed pods. The sparse glands on these seed pods were large and randomly arranged.

At the University of California, Berkeley, about 40 specimens were examined. None of the specimens labeled *P. fremontii* from California had seed pods. These could not be positively identified. Three of the Nevada *P. fremontii* specimens had seed pods. The glands were red-brown on all seed pods from the three plants. One plant came from the bajada west of Sand Canyon in the Pintwater Range near Indian Springs Valley, Nevada collected June 3, 1979. This plant had one seed pod that had many small glands with red-brown exudates that sometimes fused forming lines at the tip or the ventral portion of the seed pods (Fig. 1A). Other seed pods from this plant had small glands with small spots of exudates that tended to occur in rows. The glands were larger at the tip and the ventral part of the seed pods. Another specimen was collected from Charleston Park in the Charleston Mountains, Clark Co, Nevada on May 28, 1939. The glands on the seed pods were small with small spots of red-brown exudates and tended to occur in rows (Fig. 1B). There was no merging of glands to form lines in this specimen. Some of the *P. fremontii* seed pods had hairs regularly distributed across the pod surface. Other seed pods had hairs mostly on the dorsal part, but not on the main body of the seed pod. All the examined *P. arborescens* seed pods had just a few large glands arbitrarily distributed on the seed pod (Fig. 1C). Some of the seed pods had hairs on the dorsal edges. Plants seen in the wild had seed pods very similar to the one shown (Fig. 1C).

At the California Academy of Sciences, about 40 specimens labeled *Psorothamnus fremontii* were examined. Specimens from Utah, Nevada and Arizona had numerous small glands on the seed pods that produced clear or red-brown exudate. These exudates tended to merge and caramelize the surface of the seed pods. In addition, there were two specimens from California that had seed pods with numerous small glands that produced abundant red-brown exudate. These California specimens were from the Providence Mountains, just 3.5 mi from Kelso, and from the Lavic area that is a few miles west of the Providence Mountains (Fig. 1E, F).

Narrow- or linear-leaved *Psorothamnus* specimens, have been described from the Whipple Mountains of California (Hickman 1993). These plants have leaves that are 1 mm or less wide and have been described as *P. fremontii* var. *attenuatus*. The very narrow leaves of these plants are a distinguishing characteristic, that set them apart from *P. arborescens*. The authors have not seen these plants or seed pods from these plants. The identification of these plants will have to wait until seed pods are eventually found.

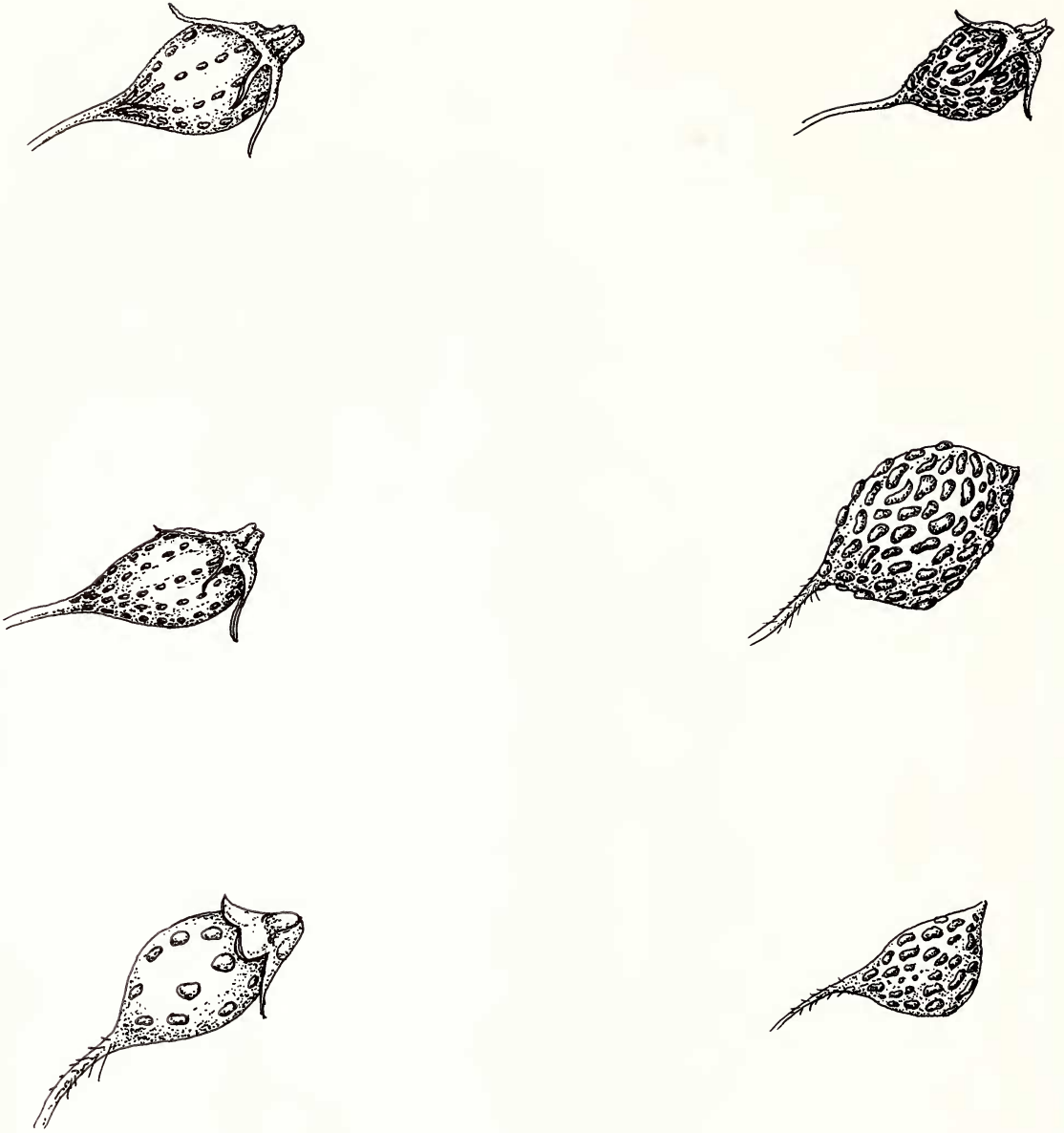


FIG. 1. Seed pods of *Psorothamnus fremontii* and *Psorothamnus arborescens*. From left to right, top to bottom, drawings are A, D; B, E; C, F. A *Psorothamnus fremontii* seed pod showing merged glands forming ridges, from a University of California Berkeley herbarium specimen at a Bajada west of Sand Canyon in the Pintwater Range, Indian Springs Valley, NV, June 3, 1979. B. *Psorothamnus fremontii* seed pod showing rows of glands, from a University of California Berkeley herbarium specimen collected in Charleston Park, Charleston Mountain, Clark County, NV, May 28, 1939. C. *Psorothamnus arborescens* seed pod showing large, scattered glands, from a University of California Berkeley herbarium specimen collected in Palm Springs, CA, December 18, 1938. D. *Psorothamnus fremontii* seed pod from Daylight Pass, Death Valley, CA, collected by the senior author on June 14, 2004. E. *Psorothamnus fremontii* seed pod from a herbarium specimen collected in the Providence Mountains, CA, 3.5 mi east of Kelso near Cornfield Springs. F. *Psorothamnus fremontii* seed pod from a California Academy of Sciences herbarium specimen found near Lavic, CA, May 20, 1920. Drawings are by Robert S. Amaral.

We have traveled extensively in the Mojave Desert of California looking for *Psorothamnus* specimens. *Psorothamnus arborescens* s.l. distribution in California extends south from Mono County to near Mt. San Jacinto. A geographically distinct popula-

tion has been reported in Northern Mexico (Isely 1998). We have found that *Psorothamnus arborescens* (A. Gray) Barneby var. *minutifolius* (Parish) Barneby occurs throughout Death Valley National Park, the White Mountains, and the Red Rock Can-

yon area. Specimens from Death Valley were collected and placed in the herbarium in the Death Valley National Park by the junior author. Identification was based on the appearance of large arbitrarily scattered glands on the seed pods. *Psorothamnus fremontii* var. *fremontii* was found only in the Grapevine Mountains along the California-Nevada border (Fig. 1D). Specimens were collected from the Grapevine Mountains, by both authors, and were placed in the herbarium at the Rancho Santa Ana Botanic Gardens, Claremont. California populations of *P. fremontii* were only previously reported to occur in San Bernardino County. The Grapevine Mountains plants had seed pods with no visible glands since the seed pods were covered with clear exudates. The exudates entirely covered the surfaces of the seed pods. The exudates were sticky enough to hold small rocks and plant material onto the seed pods. The exudates appeared to turn red-brown over time, giving the seed pods a caramelized appearance. We suggest that *P. fremontii* seed pods mature in May and June, and tend to mature after most flowers have withered on the plant. *Psorothamnus fremontii* may form only a few seed pods (20–50) on the entire plant. *Psorothamnus arborescens* seed pods mature in April and perhaps early May. The seed pods mature on the bottom of the raceme while flowers are still blooming on the top of the raceme. *Psorothamnus arborescens* may form many seed pods (more than 100) on each plant. The authors have not found both species growing together in any one area. We suggest that a more extensive investigation of the distribution of these two species should be based on seed pod characters and genetic analyses.

ACKNOWLEDGMENTS

We are grateful to Barbara Ertter of the UC Berkeley Herbaria for assistance with herbarium specimens. We thank the Rancho Santa Ana Botanic Gardens and the California Academy of Sciences for access to their herbarium specimens.

LITERATURE CITED

- BARNEBY, R. C. 1977. *Dalea* imagines, an illustrated revision of *Erazurizia*, *Psorothamnus*, *Marina* and *Dalea*. *Memoirs of the New York Botanical Garden* 27: 31–41.
- GARCIA, C. AND J. D. ADAMS. 2005. Healing with medicinal plants of the west—cultural and scientific basis for their use. Abedus Press, La Crescenta, CA.
- GRAY, A. 1855. *Plantae novae thurberianae*: the characters of some new genera and species of plants in a collection made by George Thurber, esq. of the late Mexican boundary commission, chiefly in New Mexico and Sonora. Pp. 297–328 in *Memoirs of the American Academy of Arts and Sciences*, Vol. V. Metcalf and Co., Cambridge, MA.
- HICKMAN, J. C. (ed.). 1993. *The Jepson manual: higher plants of California*. University of California Press, Berkeley, CA.
- ISELY, D. 1998. Native and naturalized Leguminosae (Fabaceae) of the United States (exclusive of Alaska and Hawaii). Monte L. Bean Life Science Museum, Provo, UT.
- SMUCKER, S. M. AND J. C. FREMONT. 1856. The life and times of Col. John Charles Fremont, and his narrative of explorations and adventures in Kansas, Nebraska, Oregon and California. Pp. 434–460 in *The memoir of Samuel M. Smucker*. Fremont, John Charles 1812–1890. Miller, Orton and Mulligan, Auburn, NY. Available at: www.hti.umich.edu/t/text/gifcvtdir/aaz9580.0001.001/04460434.tifs.gif.